Workshop Without Walls: Upstairs Downstairs

Breakout Group 3 Note-taking

Debate #4: Astronomy group

Wish list of what we want to observe, and work required to get to that point?

Question: what are the geochemical cycles of a super-Earth around an (late) M-star?

*Idea: Close-in planet, but also farther planet out in habitable zone, so the planet close to star might be outgassing (due to tidal interactions, etc.) and we could determine composition of interior of planet from transits → make assumptions about what could be going on inside the planet that's actually in the habitable zone

(bigger leap to go from stellar composition to planet composition, than going from planet to planet compositions → still have to make some assumptions)

*TESS would have to find this system first, then characterize spectroscopically with JWST

Earth atmospheric pressure has been quite stable for a long time, we have good (arguably) protection from particle loss by our magnetic field?

> If you have O2 rich atmosphere like Earth you might be more susceptible to loss? (think Venus with its CO2 atmosphere)

*UV problem on M-star planets? They are deficient in near UV, and far UV blocked by oxygen and water if the planet has that → may or may not make these planets uninhabitable?

> *But what about life that hasn't developed photosynthesis, might need UV photochemistry as beneficial to life (neglecting UV damage to DNA structure, etc.)

Ability of M-star to strip atmosphere? vs ability of planet to outgas more and replace an atmosphere? (UV ionizes upper layers, and particle flux of star comes and strips atmosphere)

Question: Is this ^^ something we understand now, or something we want to measure?
UV flux might be observable, but particle flux might be difficult to get good measurements

How well can geodynamicists predict magnetic field given size of planet? not at all.
but we don't really understand (e.g. why doesn't Venus have a magnetic field?)

> *in theory using radio, could potentially detect magnetic field strength of planets
> *but low frequencies wouldn't make it through Earth's ionosphere

*Different sorts of biosignatures than what are usually considered? e.g. Ammonia in the atmosphere of a super Earth with H rich (and N) atmospheres far away from the star, but how would you interpret that as a sign of life? but that could definitely be an abiotic process.

Question: what can we really do with Seager and Bains list of lots of biosignatures?
But looking for biosignatures like those on Earth isn't necessarily Earth-centric

> *Thermodynamics still works the same everywhere
> *Even with very alien biochemistry, by-products might be the same as on Earth
> *But, in different environment, life might evolve to choose different metabolic pathway?

Life always mimics the geochemistry that exist on a planet, so it might not be enough to look for some kind of disequilibrium in the planetary atmosphere

> Most organisms actually go down the thermodynamic gradient and DRIVE things toward equilibrium (besides maybe oxygenic photosynthesis)

Any Earth sized planet that we observe an atmosphere (that's not a H/He atmosphere) has outgassing? → geologic activity that could indicate… something?

Question: What conclusions can we make about the inside of a planet if we detect ANY atmosphere in an OLD system?

*Would transmission spectroscopy ever work for M-star? Direct imaging wouldn't work because of the size of the system (better off with an interferometer) but we don't know! haven't characterized activity of individual systems yet.

*We need to know MORE about M-dwarf stars! What **kind** of M-dwarf should JWST spend time looking at (there is a wide range of types)? Winnow down the large list of candidates.

What about K-stars? JWST isn't necessarily optimized for them, but future missions could.
It's not all just about habitability, still learning about these stars and the planets around them is really useful. We have proposal pressure, time pressure on the telescopes, etc.